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DEPARTMENT OF AGRICULTURE

CENTRAL EXPERIMENTAL FARM

OTTAWA, CANADA

BULLETIN



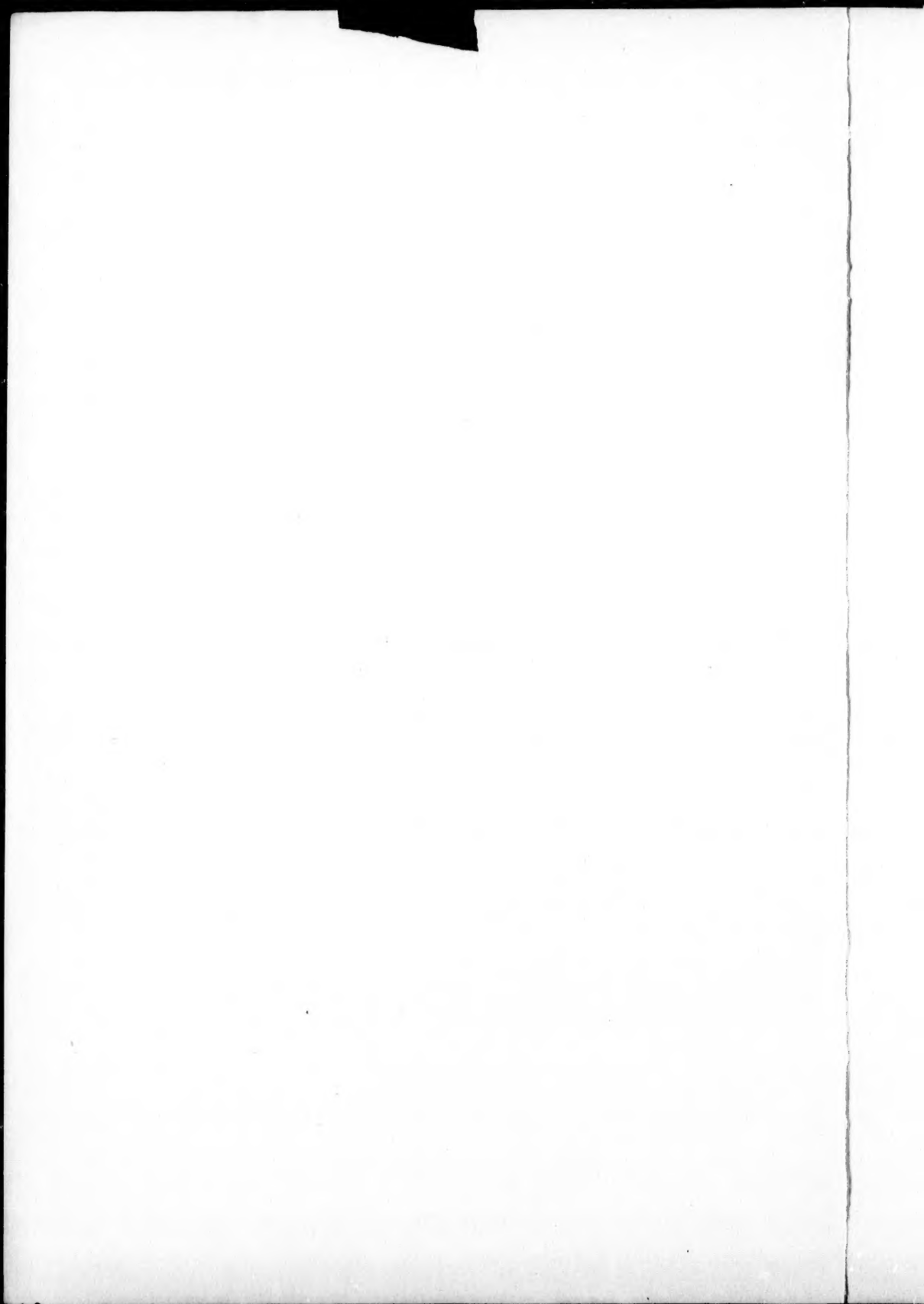
No. 25.

FLAX.

MAY, 1896.

PUBLISHED BY DIRECTION OF THE HON. W. H. MONTAGUE, MINISTER OF AGRICULTURE.

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To the Honourable
The Minister of Agriculture.

SIR,—I have the honour to submit for your approval Bulletin No. 25 of the Experimental Farm series, prepared by myself. In this bulletin is discussed the cultivation of flax, both for seed and fibre, and information given as to the preparation of the land and general treatment of this crop.

In view of the present low prices prevailing for the more important cereals, it seems desirable that the farmers of Canada should be placed in possession of all the facts obtainable regarding the smaller branches of the great agricultural industry, so that they may be the better able to avail themselves of such opportunities as may arise of adding to the profits of their work by devoting such portions of their land to these less important crops as may seem judicious and likely to give good returns.

I have the honour to be,
Your obedient servant,

WM. SAUNDERS,
Director Experimental Farms.

Ottawa, 1st May, 1896.

FLAX.

BY WM. SAUNDERS, L.L.D., F.R.S.C., F.L.S., &c.

Director Experimental Farms.

The cultivation of flax is now receiving greater attention in Canada than formerly, and the area of land devoted to this crop, especially in the province of Manitoba, has of late been largely increased. This is owing partly to the continued low prices obtainable for grain and partly to the unusually high price which flax seed brought during the autumn of 1894.

The flax plant received from the great botanist Linnæus the name of *Linum usitatissimum*. From the generic word *Linum* the words linen, lint and linseed are derived, and the specific name *usitatissimum* which means "most useful," was given to this plant in consideration of the service it has rendered the human family in supplying material for clothing. The fact that the Egyptian mummies were wrapped in linen shows that the use of flax fibre is very ancient.



Fig. 1.

Flax is an annual plant which grows from 1½ to 2 feet and sometimes to 3 feet in height. The stem branches more or less, depending much on the thickness with which the seed is sown and the relative closeness of the plants. The flower, which is shown in figure 1, of the natural size, is of a purplish blue colour, and when fully expanded measures nearly an inch in diameter. The seed pods or "bolls" have ten cells or divisions, each of which contains a single seed. The seeds are brown with a smooth and polished surface, and have a mucilaginous coating which dissolves readily in hot water. When the seed is steeped in this fluid a beverage is made known as "flax seed tea," which is used as a soothing drink in some forms of inflammatory disease. The seed is said to contain about 15 per cent of mucilage, it also yields a large proportion of oil from 22 to 27 per cent, which is known in commerce as linseed oil. To obtain the oil the seed is ground and heated by steam, and while hot is subjected to strong hydraulic pressure when the oil flows freely from the pressed material; the cake left after the oil is extracted is known as oil cake, and is much used as food for cattle.

The fibre is that which gives to flax its greatest value. On cutting through a stem of this plant the centre is found to be occupied by pith, surrounding which is a layer of ordinary woody fibres, and outside of these the inner bark which is formed of very long and remarkably tough fibres; the whole being covered by a skin or epidermis. The object of the processes of retting and scutching of the flax plant is to separate these fibres composing the inner bark from all the other portions. The fibre of flax is very tough and is well adapted for spinning, and as compared with cotton, wool or silk, it is a good conductor of heat, linen clothing being proverbially cool.

THE FLAX CROP IN MANITOBA.

In Manitoba flax is grown for its seed only; no use has yet been made of the straw, and it is claimed by practical men that the fibre in it is too short, and is too limited in quantity and poor quality to be worked with profit. The area under flax in this province in 1894 is given as 30,000 acres, and the yield averaged 12 bushels per acre, a total of 360,000 bushels. In 1895 the area under flax was 82,500 acres, and the average yield, according to the estimate of the Manitoba Department of Agriculture, was 15½ bushels per acre, giving a total production in that province of 1,281,354 bushels.

ITS PRODUCTION AND VALUE IN THE UNITED STATES.

The crop of flax seed in the United States in 1894 was a poor one, amounting in all to only about 7,500,000 bushels; whereas the average crop is about 14,000,000 bushels. This shortage resulted in high prices and flax seed in Chicago, one of the chief markets for this product, commanded during the autumn of that year from \$1.40 to \$1.50 per bushel. The duty on flax seed entering the United States is 20 cents per bushel, and a considerable quantity of the Manitoba crop was bought by United States purchasers, who paid from \$1.15 to \$1.25 per bushel for it. As the quantity of flax seed grown in North America was not sufficient to supply the demand, the home product was supplemented by large importations from India and the Argentine Republic. The flax crop of 1895 in the United States was a very large one, the area under cultivation was much increased, and the total yield of seed is estimated at nearly 19,000,000 bushels. This abundant crop has brought down the price, which has ranged of late in the principal markets of the United States at from 90 cents to \$1 per bushel; and the value in Manitoba on the basis of these prices has fallen to about 70 cents. The flax crop of the United States is produced almost entirely in the North-western States, the greater part of it in Minnesota, North and South Dakota, Iowa, Kansas and Nebraska. As in Manitoba, this crop is grown in the Western States almost entirely for the seed; the efforts which have been repeatedly made to utilize the fibre have not met with much success. It is said that here also the dry climate reduces the quantity of fibre in the straw as well as its quality, so that it does not pay to work it. A small proportion of the straw is used in factories where upholsterers' tow is produced, and also in paper mills, at prices ranging from \$2.50 to \$4 per ton; but by far the larger part is disposed of by burning.

FLAX GROWING IN THE NORTH-WEST FOR SEED.

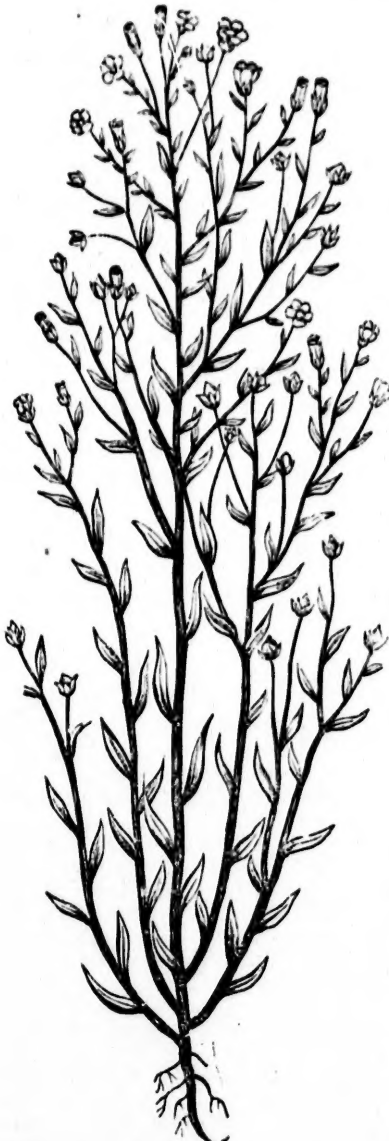


Fig. 2.

Flax can be grown on the prairie soils of the North-west on first breaking, but usually produces a heavier crop on back-setting or on a clean fallow. To make this clear to those who are unacquainted with the methods of prairie farming, it may be said that the first breaking on prairie sod is made by turning over a wide and shallow furrow about two inches thick. When this is done in the spring, the land is ready for back-setting in the autumn, by which is meant a second ploughing running across the breaking to a depth of about four inches. This cuts the decayed sod, turns it over and covers it with about two inches of fresh soil from below. Back-setting is the usual preparation for a wheat crop. Where flax is sown on first breaking, a seed bed comparatively free from weeds is provided, the farmer derives a revenue from his land the first year, and the crop effectually rots the sod so as to admit of ploughing to the ordinary depth in the autumn.

QUANTITY OF SEED PER ACRE.

When flax is grown for its seed only, it is usual to sow from two to three pecks per acre, and when thus thinly sown the plants are much branched, as shown in figure 2, and are said to average a larger yield of seed. This, however, seems to require further investigation and the character of the season may influence the results very much. From tests made on the Experimental Farm at Brandon, Man., in 1894, it would appear that heavier seeding may be desirable even when flax is grown

for the seed only. These experiments were made on plots of one-tenth of an acre each on land which had been summer fallowed, with the following results:—

Sown 16th May, 40 lbs. seed per acre, ripe 16th August, yield per acre, 19 bush. 26 lbs.

Sown 16th May, 70 lbs. seed per acre, ripe 16th August, yield per acre, 20 bushels.

Sown 16th May, 90 lbs. seed per acre, ripe 16th August, yield per acre, 20 bush. 50 lbs.

In these experiments the flax was sown with the grain drill, cut with a binder and threshed with the separator, care being taken to feed slowly.

TIME TO SOW.

Experiments were also conducted at Brandon, in 1894, in sowing at different dates, with the following results:—

Sown 11th May, 90 lbs. seed per acre, ripe 13th August, yield per acre, 18 bush. 12 lbs.

Sown 19th May, 90 lbs. seed per acre, ripe 16th August, yield per acre, 20 bush. 50 lbs.

Sown 22nd May, 90 lbs. seed per acre, ripe 22nd August, yield per acre, 21 bush. 14 lbs.

These experiments will need to be repeated for several years before any general conclusions can be drawn from them. At the Experimental Farm at Indian Head, in 1890, the heaviest crop of flax seed was produced when sown on the 17th May; while in 1891 good results were had from seed sown on the 3rd of June. From the experience thus far gained, it would appear that the best time for sowing flax throughout the Canadian North-west would be from the 15th to 25th of May. The flax plant is tender in the spring and easily injured by frost. It is less liable to injury from this cause in the autumn; but if exposed to much frost before the seed is ripe, the seeds become dark and discoloured and are then very much reduced in value.

FLAX GROWING IN ONTARIO CHIEFLY FOR FIBRE.

The cultivation of flax in Western Ontario has long been carried on mainly for its fibre, the yield of seed being a secondary consideration. The total area under cultivation is said to be from 12,000 to 15,000 acres, and the production of seed in this province for the year 1895 is variously estimated at from 95,000 to 120,000 bushels. The flax industry in Ontario has been stimulated and largely sustained through the operations of the enterprising firm of J. & J. Livingston, of Baden, Ont., who began the working up of flax products in 1864. This firm now operates large oil mills with double sets of presses for the manufacture of linseed oil, and twelve scutching mills for the manufacture of flax fibre, located in different parts of the western portion of the province. The oil mills are run night and day, from Monday morning to Saturday night, for the greater part of the year, and the consumption of seed is from 450,000 to 500,000 bushels annually. The quantity of oil produced varies from 15,000 to 20,000 barrels yearly, all of which finds a market in the Dominion. In ordinary seasons the greater part of the seed required is brought from Manitoba; but in 1894, when seed was scarce and dear, this firm imported 1,000 tons from the Argentine Republic, in order to keep their works partially going. This is the only linseed oil mill in operation in Ontario.



Fig. 3.

Ontario during the past year is said to have been from eight to nine bushels per acre, and the weight of straw has averaged about $1\frac{1}{2}$ tons. The fibre manufactured in Canada finds a ready market in the United States and in England.

To grow flax successfully for fibre, a moist climate is said to be necessary. In a season when the rainfall is deficient, as it was in some sections of Ontario during 1895, the fibre produced is smaller in quantity and is inferior in quality. There are from 40 to 45 scutching mills in Western Ontario where flax fibre is produced, and each mill will work up from 300 to 600 acres of flax, which usually produces an average of 3,000 to 3,500 lbs. of straw per acre. The quantity of seed sown in Ontario is about 80 lbs. per acre, which is said to be sufficient to cover the ground well and produce a thick growth, giving a long and straight straw which yields a fibre of good quality. Fig. 3 represents a plant of a crop thus grown, mainly for fibre. The seed is sown from the middle of April to the middle of May, commonly by a broadcast machine, but sometimes by hand, and the seed is covered by a light harrowing. Where flax is grown for its fibre it is always pulled in harvesting. There are two methods followed in the raising of this crop. In one the proprietors of the mills rent the land on which flax is to be grown at from \$8 to \$10 per acre. The farmer in this arrangement prepares the ground by ploughing and harrowing, and the owner of the mills grows and harvests the crop. In the other case, the farmer grows and harvests the crop and sells it to the proprietors of the mills usually at \$10 per ton for the dried crop, selling the seed with the straw. When the season is favourable and the land in good condition for this crop, it is not uncommon for the farmer to grow from two to three tons per acre. In some localities men are employed in pulling; in others the larger part of this work is done by women and children. The cost of pulling is usually from \$4.00 to \$5 per acre. A man who is a good puller can make from \$1.25 to \$1.50 per day at this work. The women earn from 75 cents to \$1 per day, and children from 10 to 15 years of age from 30 to 75 cents per day. The crop as pulled is tied in bundles or small sheaves, which are placed for a time in stooks in the field and when dry it is drawn to the storehouses. It is threshed by the use of a special machine which separates the seed without injuring the fibre in the straw, and the straw is subsequently retted and scutched and the fibre thus prepared for the market. The average yield of seed in

FLAX CULTURE IN OTHER PROVINCES.

Flax is grown successfully over the larger part of the settled portions of Quebec, where it is cultivated, in comparatively small areas, chiefly for its fibre, for household purposes. It is retted, scutched, spun, and made into fabrics for household use by the thrifty wives and daughters of French Canadian farmers. Flax is also grown successfully in the Maritime Provinces and in British Columbia.

OIL MILLS IN OTHER PROVINCES.

There is a linseed oil mill in Winnipeg that has been in operation for several years, which has a capacity for manufacturing from 80 to 90 barrels per week, using 2,000 bushels of seed. This oil, which is made entirely from Manitoba seed, usually supplies the home demand; and when seed is plentiful and there is more made than is required in the province the surplus is sent to the other provinces of the Dominion. A new mill is also in process of erection at Mission, in British Columbia, where, it is proposed, to supplement such seed as can be grown in that province by importations from Manitoba and South America. There is also an oil mill near the city of Quebec, which was in operation in 1893, but has not been working of late.

IS FLAX A SPECIALLY EXHAUSTING CROP?

This question is usually answered in the affirmative, but this opinion does not appear to be warranted by the chemical analyses which have been made of this crop, showing the principal elements of fertility taken from the soil during the period of its growth. The results which have been obtained by chemical examination may be summarized as follows:—

An acre of flax producing 15 bushels of seed and 2,000 lbs. of straw, takes from the soil—

	Nitrogen in lbs.	Phosphoric Acid in lbs.	Potash in lbs.
For the seed, 840 lbs.	26	14·86	9·28
“ straw, 2,000 lbs.	20	9	28
Total	46	23·86	37·28

If we compare this with a crop of wheat yielding 25 bushels of grain per acre and 2,200 lbs. of straw, we find that the wheat takes from the soil—

	Nitrogen in lbs.	Phosphoric Acid in lbs.	Potash in lbs.
For the grain, 1,500 lbs.	28·50	12·68	8·54
“ straw, 2,200 lbs.	12·03	4·96	10·57
Total	40·53	17·64	19·11

If we compare the figures given with those from a crop of oats of 50 bushels to the acre with 2,200 lbs. of straw, we find that there is taken from the soil by the oat crop:—

	Nitrogen in lbs.	Phosphoric in lbs.	Potash in lbs.
For the grain, 1,760 lbs.....	32.13	10.48	8.05
“ straw, 2,200 lbs.....	13.90	4.74	24.83
Total	46.03	15.22	32.88

The greater part of the straw of all these crops grown in the North-west is usually burnt, when the mineral ingredients taken from the land are returned to it in the form of ashes. In the east, where the straw is utilized chiefly for bedding animals, the mineral constituents taken up are returned to the soil with the manure, hence the seed only need be considered. It will be seen that the grain, in the case of the wheat crop, takes up a little more nitrogen and somewhat less of phosphoric acid and potash than is taken by the flax seed; while the oat crop takes for the grain a larger proportion of nitrogen, nearly one-third less of phosphoric acid and about one-eighth less of potash. The difference, however, in exhaustive effect of these several crops on a rich soil would scarcely be perceptible, and would not justify the opinion that flax is a very exhausting crop. In some experiments tried at the Experimental Farm at Brandon, Man., during the past year, in sowing wheat, oats and barley after flax, the results obtained point to the same conclusion.

GENERAL CONSIDERATIONS.

In the growing of flax, one of the first requisites to success is to have the land as free as possible from weeds. In the selecting of the seed for sowing also see that it is free from weed seeds, and the heaviest, brightest and plumpest samples of seed should be preferred. As flax grown for fibre undergoes more or less deterioration each year, the proprietors of flax mills usually import some fresh seed every season from Belgium, Holland or Russia for distribution among their patrons. It is said that the seed is at its best the second year from importation.

In those parts of Europe where the production of fibre is the prime object, $1\frac{1}{2}$ to 2 bushels of seed, and sometimes more, is sown per acre. In Belgium, where some of the finest quality of fibre is produced, flax is said to succeed best in deep and well cultivated soils that are not heavy. In a dry, calcareous soil the plant grows short; while in a heavy clay soil, although the growth is long, it is said that the fibre is not so valuable. In Ireland any good fertile soil which has been well prepared by thorough cultivation, and is rich enough to produce good crops of cereals is held to be suitable for flax.

In the north-western parts of America, it is common to grow flax after wheat or oats; but no regular system of rotation is followed. In Europe where the soil is not so fertile and new, a systematic rotation is practised with heavy manuring. It is not often that the flax crop is allowed to recur on the same ground oftener than once in five years, and in some districts not oftener than once in seven or eight years. A common rotation is said to be: oats, rye, wheat, clover and flax. Clover is regarded as one of the best crops to precede flax, as its roots penetrate deep into the soil, and bring up stores of fertility from below which most other plants do not reach. Clovers also assimilate and store up nitrogen from the air, and when turned under, furnish much plant food for the crop that is to follow.